**Unit 2 Part 2 Notes Questions – Properties of Water - Key**

**Vocabulary:** Choose two sets of two vocabulary words from your notes. Define each term in the set and identify a connection between the two terms in the set. The definitions and connections must be in your own words and in complete sentences.

1. Terms: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Definitions and Connection:

Example Terms: High Heat of Vaporization and Evaporative Cooling

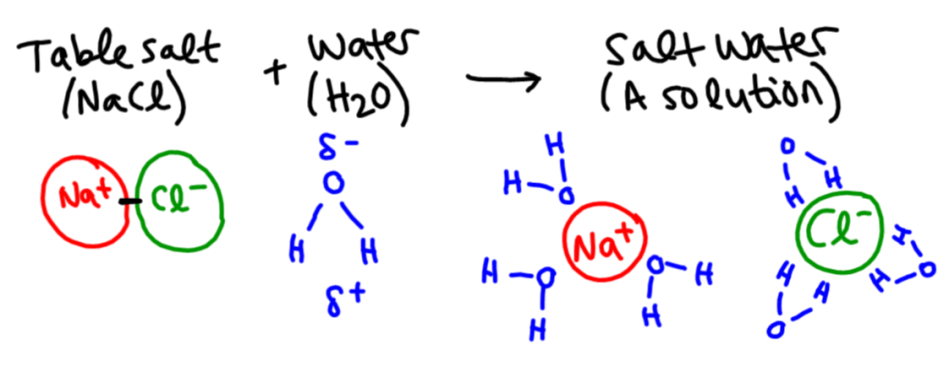
Water has a high heat of vaporization, which means it takes a lot of heat energy to change water from a liquid to a gas. Because water takes in a lot of heat energy during this conversion, organisms that lose water due to evaporation of water (i.e. sweating in some animals) are cooled down.

2.Terms: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Definitions and Connection

Example Terms: Polar Molecule and Universal Solvent

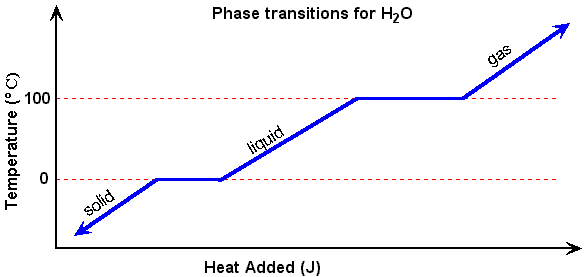
Because water is a polar molecule (i.e. has oppositely-charged regions), it is able to isolate charged ions of compounds like NaCl (breaks down into Na+ and Cl-), thereby dissolving the substance. See picture below.



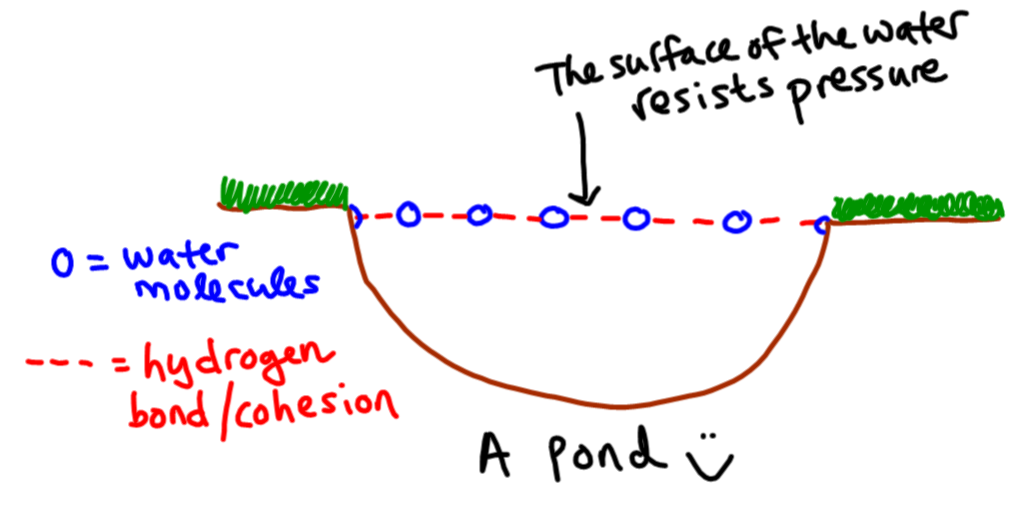
1. Explain why the temperature of water changes very little as it changes phase from solid to liquid and liquid to gas. Use the term “high specific heat / heat capacity” in your response.

Water has a high specific heat (defined as the energy required to raise the temperature of 1 gram of water 1 degree Celsius). Water has a high specific heat because hydrogen bonds between water molecules must be broken to raise the temperature and allow water molecules to move more quickly (i.e. higher kinetic energy).

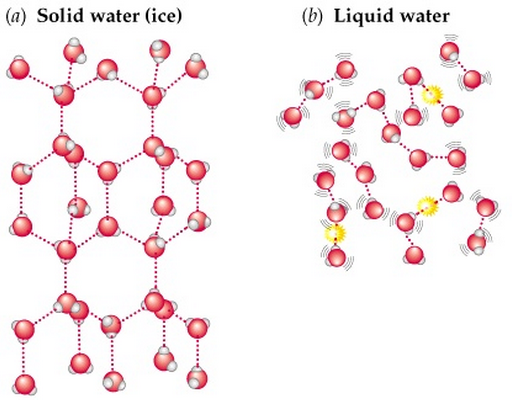
When water changes phase, a large number of hydrogen bonds must be broken, so a large amount of heat energy must be absorbed at these times, though there is no corresponding temperature change until the water has changed phase.



2. Explain why a water strider insect can walk on the surface of a lake or pond. Use the terms hydrogen bonding, cohesion, and surface tension in your response.



Hydrogen bonding between water molecules on the surface of a lake or pond causes water molecules to stick together (i.e., cohesion). This results in the formation of a thin “film” that resists changes in pressure (i.e. surface tension)… this is why a water strider insect can “walk on water” (it spreads out its weight so as not to break the surface tension).

3. Explain why ice floats on liquid water. Use the term “hydrogen bonds” in your response. Use the image to the right to help you answer the question.

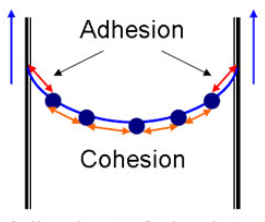
Water is less dense as a solid ; when water freezes, more hydrogen bonds form pushing water molecules farther apart (see left portion of image) 🡪ice is less dense than liquid water . Because ice is less dense than liquid water, it floats when placed in liquid water.

4. Describe the difference between a hydrophobic and hydrophilic substance. Use the terms “polar” and “nonpolar” in your response.

Hydrophilic substances typically contain polar molecules and as such, are attracted to water (water loving)

Hydrophobic substances typically contain nonpolar molecules and as such, are repelled by water (water fearing).

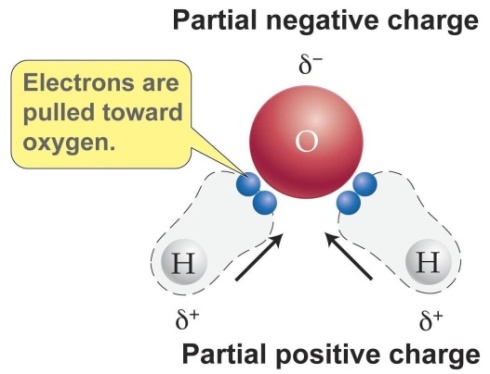
5. Define capillary action and explain how adhesion and cohesion cause capillary action.

Adhesion occurs within a thin tube between the water molecules and molecules on the sides of the tube

Cohesion occurs between water molecules that are pulled up on the side and water molecules in the middle

Capillary action is the movement of water up a narrow tube due to two forces – cohesion and adhesion

6. Explain why water is a polar molecule and explain how water’s polarity contributes to its ability to form hydrogen bonds with other water molecules.

Within water, oxygen holds shared electrons (in a covalent bond) more tightly than hydrogen 🡪 oxygen has a slightly negative charge, hydrogen has a slight positive charge (see image to the right). A molecule that has positive and negative regions is considered a polar molecule.

The slightly negative charge on water’s oxygen atom allows it to form hydrogen bonds with other molecules that have a slightly positive hydrogen.

The slightly positive charge on water’s hydrogen atoms allows it to form hydrogen bonds with other molecules that have a slightly negative nitrogen, oxygen, or fluorine.

7. If water molecules surround a solute particle with their oxygen ends all pointing to the solute particle, what can you conclude about the charge of the solute particle? Is it positive, negative, or neutral, and how do you know?

The solute particle must have a positive charge because the oxygen ends of water molecules are slightly negative and opposite charges attract.

8. How does the concentration of hydrogen atoms in a solution with a pH of 2 compare with the concentration of hydrogen atoms in a solution with a pH of 5?

*Ex: “The concentration of hydrogen atoms is 10 times lower in a solution with a pH of 2 than a pH of 1.”*

Solutions with lower pH values have higher concentrations of hydrogen atoms.

Because a pH of 2 and a pH of 5 are 3 pH units apart, there is a103 or 1,000 times difference in their hydrogen ion concentrations.

So… The concentration of hydrogen atoms is 1,000 times higher in a solution with a pH of 2 than a pH of 5.